The E-Equity Index™

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Premise: Everything begins and ends with the earth!

- We convert natural resources for beneficial use by mankind and these materials are then returned in altered form to the earth or the atmosphere.
- The challenge is to minimize the impact to the planet and living things “in the interim.”
- To date, our thinking in facing this challenge has been stifled by institutions (political, financial, social) that seek local “maxima” instead of a broader *system* or *planet*-optimum goal.
  - Environmentalist-lowest emission
  - Investor-highest return on invested capital
  - Utility-lowest production costs
  - Community-highest employment

A New Industry Order: Electricity Production, delivery

Wholesale market

- Fully deregulated
- Significant hedging/trading
- Energy storage for arbitrage
- Flexible/truly dispatchable power stations (coal, gas)
- New private DC lines
- Conversion to some private AC transmission
- FLEXIBILITY, COMMODITY MARKET MENTALITY. ARBITRAGE-DRIVEN

Retail market

- Mostly deregulated
- Distributed power, micro-, mini-grids
- Natural-gas drive
- CUSTOMER-DRIVEN SERVICES
- Demand-side and conservation
- Little trading and hedging (except for big-load customers
- Power quality management

The Electricity Infrastructure BACKBONE

- Mostly regulated or large government role
- Energy storage for ancillary services
- Low cost but inflexible baseload stations (coal, nuclear)
- Fee-for-service
- RELIABILITY AND SECURITY DRIVEN
- Incremental rates of return over costs

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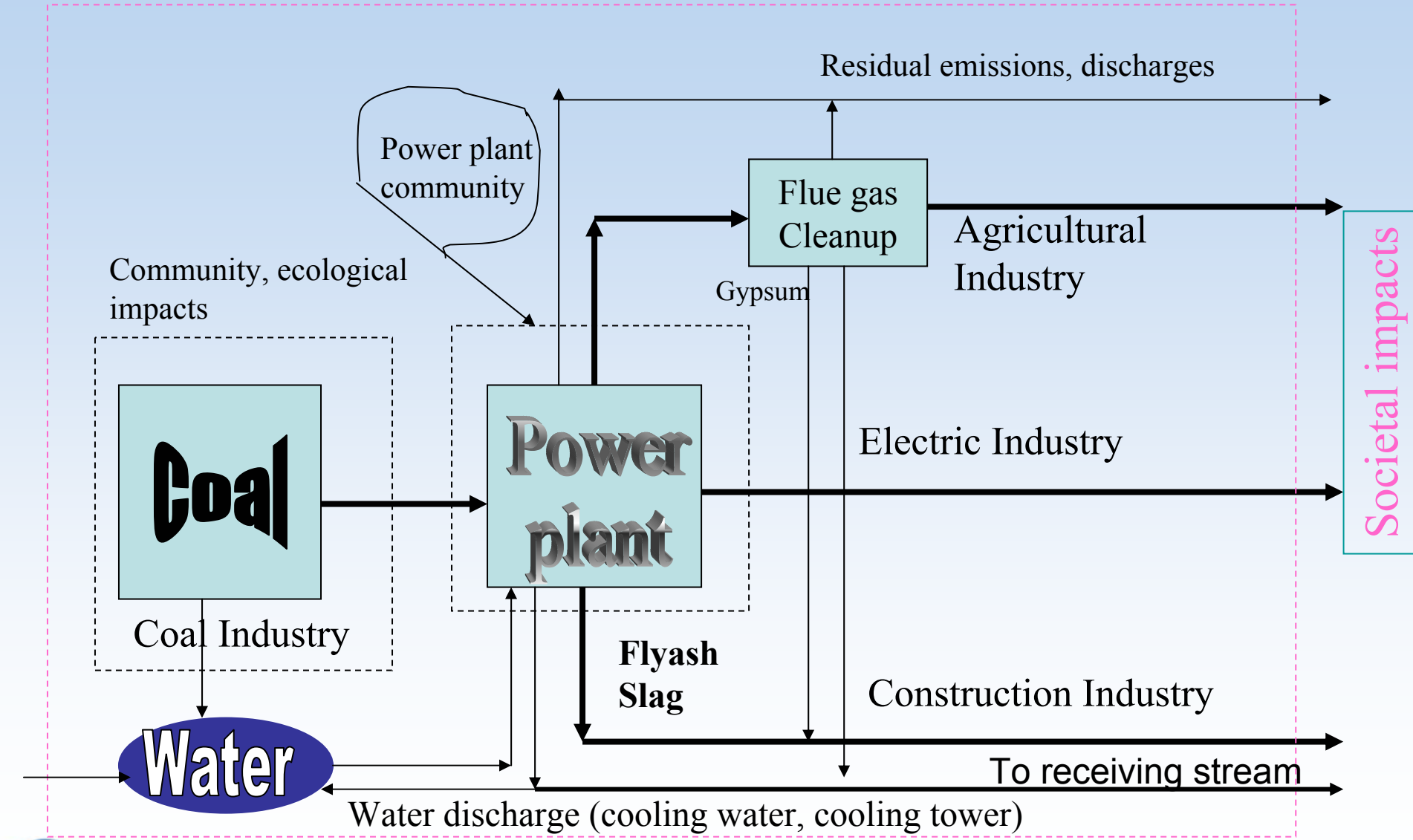
Problem: Valuing externalities

- Externalities—negative impacts on society ("costs") from business or industrial processes that are not properly reflected in the "price" of the product.
  - Externalities are not merely environmental. i.e. they can be safety-related
- What is the opposite of an externality? Internality
- Internalities—positive impacts on society that may not be properly reflected in the financial model.
  - National security, price stability and predictability, employment, tax base, beneficial recycling, etc

Problem: Valuing externalities

- Coal-fired facilities are penalized for externalities but not rewarded for internalities!
- Externalities-SOx, NOx, Hg, CO2, flyash emissions; water discharges; impacts from mining
- Internalities-recovering/reusing flyash for cement; avoiding accidental deaths (such as from pipeline explosions); restoring mining areas
- New internalities-gypsum-, acid-, fertilizer-producing FGD; recycling water from wastewater treatment plants; indigenous fuels and geopolitical implications; employment

E-Equity considers extraction of full value of coal in the context of full environmental, community, social impacts using principles of industrial ecology



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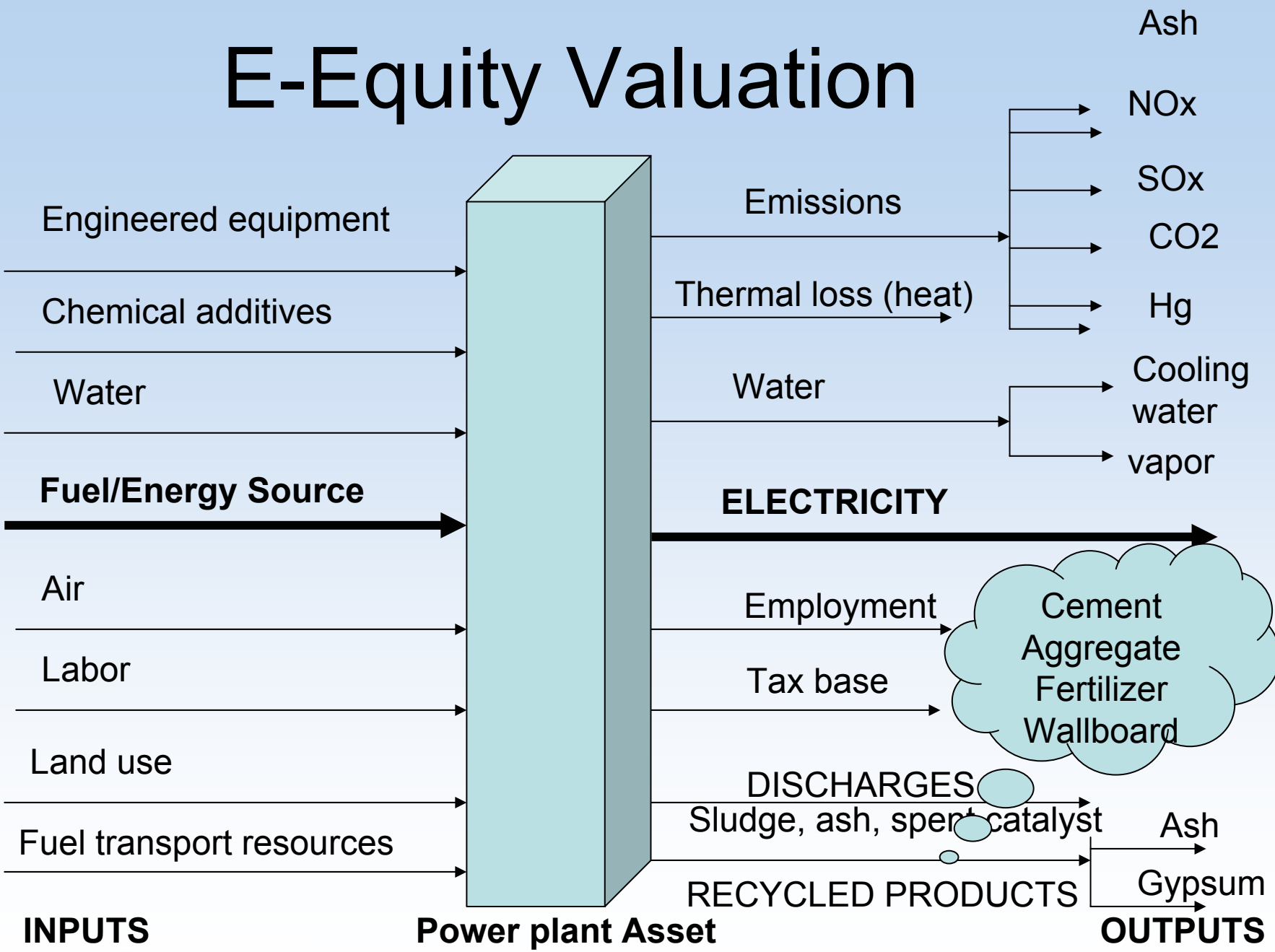
What is the goal?

- Drive the R&D, design, development, and engineering process(es) to maximize the internalities and minimize the externalities while keeping the price of the product reasonable.
- Transform externalities (negatives) to internalities (positives)
- In electricity production, this is close to impossible given the present state of our institutions (utilities, regulators, etc)
- DRIVE TOWARDS A SYSTEM OPTIMUM, NOT AN ARRAY OF LOCAL OPTIMUMS

Definitions:

- **Equity *n*, A set of principles intended to enlarge, replace, enhance, or expand a narrow, rigid system of laws.**
- **E-Equity *n*, The thermodynamics-based principle that emissions and discharges from a power station are simply a measure of inefficiencies that penalize both the economics of the facility and the ecology of the physical surroundings.**
- **E-Equity Methodology, a new way of thinking about power stations to drive towards a "system optimum" based on the principles of industrial ecology**
- **E-Equity Index, The result of a quantitative evaluation of a power plant's E-Equity that benchmarks it against its peers, against other power plants, etc.**

E-Equity Valuation



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E-Equity Valuation indices

- Fuel to electricity conversion efficiency
- Total land use ratio to total energy output
- Measure of water recycle rate
- Ratio of emissions level to level known to cause human health problems
- Recycle ratio for recovered products
- Comparative probability of catastrophic failure and measurable impact
- Measure of tax revenue and employment on micro-economy of region or community
- Value of indigenous fuel source to national security
- Value of grid reliability/availability relative to plant location (vs import of power across the grid)
- Impact on community micro-economy resulting from arbitrage capability
- Plant flexibility over the life of the physical assets (how well it responds to market and emergency conditions (e.g. ancillary services

E-Equity Methodology

- Apply principles from the emerging field of industrial ecology to the valuation of coal-fired power plants and advanced coal-fired technologies
- Evaluate the coal facility with respect to positive and negative impacts upstream (e.g. fuel production and delivery) and downstream (beneficial byproducts, stack emissions) by quantifying externalities and internalities
- Broaden traditional modeling techniques employed for power generation, transmission, and economies to consider all inputs/outputs
- Value subjective factors such as national security, long-term price stability, overall catastrophic risk, safety, etc.

What can you do with E-Equity?

- **Benchmark the performance of a power plant to its peers on a more holistic basis that gets beyond dollars. Develop "best-practices" guidelines for the industry**
- **Realistically compare the real value of advanced coal-fired technologies to society and different options for siting coal-fired plants (i.e. mine-mouth plants—tradeoffs between location near fuel supply and location near load, optimize over generation, transmission, air, and land disposal)**
- **Communicate the "holistic" value of a coal-fired facility, a coal-fired fleet, etc to stakeholders**
- **Develop a less parochial, more robust regulatory paradigm that encourages multi-pollutant emissions control technologies, sale of byproducts, etc., and that avoids inadvertent poor performance, under-utilized assets (e.g. low capacity factors), etc.**
- **Help establish the value of vertical industries (electric utilities, fuel production, fertilizer/chemicals, construction, etc) working together to achieve planet optimum efficiencies, not local (or sector-specific) efficiencies.**

Where do we go from here?

- Build a mathematical, computational model based on the E-Equity methodology
- Leverage Capabilities of Existing Models (Regional Market Models, Unit Commitment, Fuel Supply, Transport)
  - Integrate Models to Generate both Intrinsic and Extrinsic Value from All Inputs/Outputs
  - Estimated Cost → $150k – 250k
- Partner with a flagship coal-fired plant or advanced coal process developer to test the model with real inputs, outputs
  - $50K
- Partner with Regional Power Portfolio Owner to Assure Model Can Address More Complex Market Issues
  - $50k - $100k

COMMERCIALIZE THE MODEL FOR APPLICATIONS NOTED HERE.